

# IWER2009

## INTERNATIONAL WORKSHOP ON EVAPORATION FROM RESERVOIRS

Gold Coast, Queensland, Australia  
9-11 December, 2009

### Abstract Submission

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Abstract Title	<b>EvapCalc – A MODEST-COST TECHNIQUE FOR REAL-TIME MEASUREMENT OF EVAPORATION (AND SEEPAGE) FROM FARM DAMS</b>
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Extended Abstract:
<p><b>EvapCalc – A MODEST-COST TECHNIQUE FOR REAL-TIME MEASUREMENT OF EVAPORATION (AND SEEPAGE) FROM FARM DAMS</b></p> <p><b>N.H.Hancock and T.W.Symes</b></p> <p>Non-consumptive water loss from farm reservoirs ('dams') comprises evaporation and also seepage because these storages are commonly unlined. It follows that for such dams actual evaporation measurement by geometry and simple water balance has hitherto been rendered seriously inaccurate, or at least highly uncertain due to the inability to partition the non-consumptive water loss. The alternative approach of assessing evaporation from the open water surface as atmospheric demand (by computation from atmospheric variables) is recognised as involving considerable uncertainty and the result is usually labelled an estimate (unless very detailed measurements are undertaken with high quality instrumentation).</p> <p>This paper reports a measurement technique, encapsulated in software labelled 'EvapCalc', which for typical farm dams achieves the required partitioning of non-consumptive water loss and hence relatively accurate evaporation measurement. The technique uses water balance measurements in parallel with either standard local environmental measurements (Penman-Monteith-type 'automatic weather station' on-site) or localised Bureau of Meteorology data (e.g. SILO database:</p>

<http://www.longpaddock.qld.gov.au/silo/>). The result is high-accuracy evaporation (and seepage) information at modest instrumentation cost. The technique and its implementation within EvapCalc comprises six steps:

1. Measurement of short-interval (15-minute) water loss via precision (<1mm depth) water depth change measurement using a submerged pressure-sensitive transducer (PST).
2. Simultaneous short-interval *estimation* of atmospheric evaporative demand, i.e. of actual evaporation from the open water surface.
3. Exclusion of days which have any periods (particular 15-minute intervals) of significant uncertainty in either the water balance measurement (e.g. due to detected rainfall or dam pumping operations) or in the evaporation estimate (e.g. due to AWS sensor failure or data unavailability).
4. Linear regression of all remaining 15-minute water loss and evaporation estimate pairs to derive a line of best fit based on the *a priori* estimation of the relative uncertainty in the two data sets.
5. Extrapolation of the fitted regression line to the evaporative-demand-equals-zero axis: the intercept on this axis then indicates seepage loss.
6. The rate of seepage, assumed constant, is then subtracted from the change-in-depth water loss measurements to yield a *measurement* of actual evaporation.

The evaporation measurement produced is then largely independent of the uncertainties inherent in the estimation of open water surface evaporation from atmospheric measurements alone.

In the paper practical details are set out for each step, in particular PST usage [Step 1] and the need for custom temperature calibration; estimation [Step 2] from AWS and water temperature data (Penman-Monteith, FAO56-formulation with modifications incorporating energy storage in the water body, albedo change with sun angle, and an area-dependent wind speed function); and the regression procedure [Step 3].

Results of the use of EvapCalc on a range of farm dams are presented, and also the results of sensitivity analysis with respect to alternative estimation formulae [Step 2]. The latter indicate that even with gross deficiencies in the atmospheric-demand estimate (e.g. the omission of water body energy storage consideration), the seepage loss determined – hence the measurement of actual evaporation (from the water balance) – are not greatly affected. Finally the applicability of the technique in relation to the configuration and management of typical farm dams is discussed. Likewise, the potential limitations with respect to other, non-farm reservoirs are also discussed.

It is concluded that the technique of EvapCalc is a useful practical tool for modest-cost open-water evaporation measurement.